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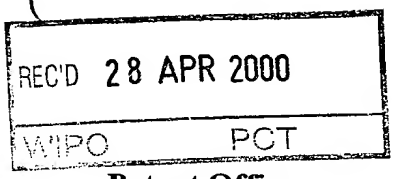

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I, KAY WARD, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. PQ 1653 for a patent by M. RAFFAELE and P. RAFFAELE filed on 15 July 1999.

WITNESS my hand this
Eleventh day of April 2000

K Ward

KAY WARD
TEAM LEADER EXAMINATION
SUPPORT AND SALES

This invention relates to the scotch yoke type engines and in particular to the connecting mechanisms between the crank mechanism and the pistons. The invention described herein is a development of the inventions disclosed in our earlier filed Australian provisional patent application Nos. PP9266, PP9306, PP9573, PQ0287, PQ0795, PQ0895, PQ0972 and PQ0989, the contents of which are expressly incorporated herein.

In our earlier applications we have disclosed reciprocating piston devices in which two pistons mounted on a common big end reciprocate at about 90° with a slider type connection between the piston and big end.

The invention, in another broad form, also provides a fluid device, which includes:

a crank mechanism including a big end bearing which orbits about a main axis, the big end bearing having a big end axis;

connecting means rotatably mounted on the big end bearing for rotation about the big end axis;

at least one piston mounted for reciprocal motion in a respective cylinder along a piston axis;

intermediate connecting means interconnecting the at least one piston with the connecting means;

means for adjusting the position of the intermediate connecting means relative to the at least one piston or the connecting means or both.

The means for adjusting may include a slot, groove or surface which engages the intermediate connecting means.

The intermediate connecting means preferably engage in or with guide means to stabilise the at least one piston in the respective cylinder. Preferably the means for adjusting includes the guide means, but the guide means may be separate.

The means for adjusting may be movable transversely or longitudinally relative to the cylinder axis or both. The guide means may be rotatable about an axis.

The means for adjusting may include a linear, single radius curved or multi radius curved slots, grooves, surfaces or the like. The intermediate members may include sliding or rolling contact members to engage the means for adjusting.

The means for adjusting may be movable to change the effective stroke of the pistons, the effective compression ratio of the device or the position/time path followed by the pistons or a combination of any of the foregoing.

The invention shall be better understood from the following non-limiting description of preferred embodiments and the drawings, in which:

Figure 1 is a cross-sectional view of a first embodiment of the invention.

Figure 2 is a cross-sectional view of a second embodiment of the invention.

Figure 3 is a cross-sectional view of a third embodiment of the invention.

Figure 4 is a cross-sectional view of a fourth embodiment of the invention.

Figure 5 is a cross-sectional view of a fifth embodiment of the invention.

Figure 6 is a cross-sectional view of a sixth embodiment of the invention.

Figure 7 is a cross-sectional view of a seventh embodiment of the invention.

Figure 8 is a cross-sectional view of an eighth embodiment of the invention.

Figure 9 is a cross-sectional view of a ninth embodiment of the invention.

Figure 10 is a cross-sectional view of a tenth embodiment of the invention.

Figure 11 is a cross-sectional view of an eleventh embodiment of the invention.

Figure 12 is a cross-sectional view of a twelfth embodiment of the invention.

Figure 13 is a cross-sectional view of a thirteenth embodiment of the invention.

Figure 14 is a cross-sectional view of the figure 13 embodiment in a different position.

Referring to Figure 1 there is shown a reciprocating piston device 10 having a crank 12, pistons 14 reciprocating in cylinders 16 and a connecting mechanism 18 rotatably mounted on the big end 20 of the crank 12. The connecting mechanism 18 engages intermediate members 22. Connecting rods 24 connects the members 22 with the respective piston 14 and the connecting rods 24 are pivotably attached to the piston 14 and members 22.

The intermediate members 22 have a sliding arm 26 mounted in a slider 28. The slider 28 defines a linear slot parallel to the respective cylinder axis 30. The intermediate member is thus constrained to move parallel to the cylinder axis. The connector 18 is limited to motion relative to the members 22 which is perpendicular to the cylinder axis and so as the crank rotates the pistons are caused to follow a true sinusoidal path.

Figure 2 shows an embodiment similar to that of Figure 1 and accordingly the same numbers are used for like parts. In the Figure 2 embodiment the intermediate members 22 engage in sliders 40 which are pivoted about a common axis 42. This axis is on a line passing through the crank axis 44 which bisects the angle between the two cylinder axes 30. The sliders 40 may be rotated about the axis 42 so that the slider axes 46 are not parallel to the cylinder axes 30. This causes the intermediate members to travel at an angle to the cylinder axes, so reducing the effective stroke of the device. Sideways motion of the intermediate members 22 relative to the pistons is accommodated by the pivotable connection of the respective connecting rod 24 to both the piston and member 22. The effect is to superimpose a secondary sinusoidal motion due to this sideways motion on the sinusoidal motion caused by the rotation of the crank.

Figure 3 shows an embodiment similar to that of the Figure 2 except that the sliders 40 are mounted upon separate axes 50, 52. As with the Figure 2 embodiment movement of the sliders 40 about their axes of rotation causes a change in stroke length and motion of the pistons.

Figure 4 shows a variation in which the intermediate members 22 engage in a unitary slider 60, which in turn is rotatably mounted on the crank itself, so as to be rotatable about the crank axis. Other than positioning of the axis of rotation, this embodiment functions identically to the Figure 2 embodiment.

Figure 5 shows a further variation in which the intermediate members 22 are mounted in sliders 62 pivoted about axes 64. As with the Figures 2 and 3 devices, rotation of the sliders results in changes to the motion and stroke length of the device.

Figure 6 shows an embodiment having a two part piston 70, having an outer piston 72 and an inner piston 74. The outer piston 72 is equivalent to the piston 14 of the earlier embodiments. The inner piston 74 is slidably mounted in the outer piston for motion parallel to the cylinder axis. A linkage system 76 connects inner piston 74 to a secondary slide member 76 mounted in a secondary slide 78.